RED ROCK TARPLANT
Hemizonia arida Keck

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Management Status: Federal: USFWS Species of Concern
California: Rare, S1.2, G1 (CDFG, 1998)
CNPS: List 1B, R-E-D code 3-2-3 (Skinner and Pavlik, 1994)

General Distribution:

Red Rock tarplant is a very local endemic of the western El Paso Mountains in the Mojave Desert of eastern Kern County and has never been found in any other location (Tanowitz, 1982; Skinner and Pavlik, 1994).

Distribution in the West Mojave Planning Area:

The entire distribution of this species is within the WMPA. Traditionally it has been reported only from Red Rock Canyon (e.g., Tanowitz, 1982), but it is now known to occur in adjacent Last Chance Canyon as well (Faull, 1987). In Red Rock Canyon it was reported to be restricted to one seeping area in the canyon in the vicinity of the Hwy. 14 crossing (Twisselmann, 1967), but actually apparently extends almost continuously for a distance of about 4-5 miles (6.5-8 km) along the canyon bottom (Faull, 1987; pers. comm.).

Natural History:

Red Rock Tarplant was not described as a species until 1958, although it had been collected as early as 1935 (Tanowitz, 1982). It has been collected a number of times since its description, but otherwise remains remarkably little known.

Red Rock tarplant is an annual sunflower (Asteraceae) of open moist sites in the El Paso Mountains on the western Mojave Desert. It is illustrated in Ferris (1960). Like other species of *Hemizonia*, this plant is characterized by the possession of both ray and disk flowers; a single row of chaffy bracts between the ray and disk flowers; a single series of phyllaries, each subtending and half-enclosing a ray achene; fertile (i.e., producing good seed) ray achenes; a disk pappus of scales or bristles, or in this case absent, and not plumose or bristle-tipped; and foliage lacking tack-shaped glands (Hickman, 1993). The disk flowers do not produce fertile achenes (M. Faull, pers. comm., 1998). Red Rock tarplant is in the section *Madiomeris* which is identifiable by presence of an annual habit, beaked ray achenes, chaffy bracts restricted to a fused outer ring, and a lack of spinose tips on the leaves and phyllaries (Tanowitz, 1982). This species is separable from other members of section *Madiomeris* by the combination of yellow anthers, absence of a pappus on all achenes, possession of solid stems and villous foliage, and deeply toothed basal leaves (Tanowitz, 1982; Hickman, 1993).

Recent observations (M. Faull, pers. comm.) indicate that Red Rock tarplant usually has 8 ray flowers, but not uncommonly has 10, and a few individuals can have up to 12-14 rays on early flowers in a wet season. Conversely, particular individuals have

been observed to display a decreasing number of ray flowers as their life cycle proceeds, with some plants having as few as 3 ray flowers per head by the end of the growing season (M. Faull, pers. comm.).

The Red Rock tarplant's closest relative appears to be Kern tarplant (*H. pallida*) from the Central Valley of California (Twisselmann, 1967; Faull, 1987). There is a low degree of fertility in crosses between Kern tarplant and Red Rock tarplant, but Red Rock tarplant is completely incapable of forming fertile hybrids with any of the other four species with which it has been crossed (Clausen, 1951). Apparent natural hybrids between Red Rock tarplant and Kellogg's tarplant (*H. kelloggii*) have been reported at Red Rock Canyon (Faull, 1987), but all studied hybrids between these species were sterile (Clausen, 1951), as is often the case for interspecific crosses in *Hemizonia* (Kyhos, et al., 1990). More recent observations have suggested the plants thought to be Kellogg's tarplant are actually Mojave tarplant (*Hemizonia mohavensis*), but this remains to be confirmed (Faull, pers. comm., 1998). It appears likely that Red Rock tarplant and Kern tarplant are descendants of a relatively recent common ancestor, perhaps similar to or identical with, Kern tarplant. Perhaps an originally continuous tarplant population was broken in two by the rise of the southern Sierra Nevada and Tehachapi Mountains (Clausen, 1951; Twisselmann, 1967). After long isolation and large population fluctuations, genetic drift, along with natural selection for a different set of characteristics in the distinctive environment of Red Rock Canyon, may have resulted in speciation.

Unlike most species of *Hemizonia*, Red Rock tarplant is self-compatible (Tanowitz, 1982). Tanowitz reported (1982) that it is the only self-compatible species in the genus, but it has since been discovered that Mojave tarplant is also self-compatible (B. Baldwin, pers. comm., 1997). The two self-compatible species in the genus are thus ones that occur as local populations on the edge of the desert, rather than as extensive populations in the dry grasslands and shrublands of the coastal slope. Most *Hemizonia* species are highly dependent on outcrossing and in fact are unable to produce fertile seed even in crosses with closely related individuals (B. Baldwin, pers. comm., 1997). It is probable that lack of self-fertility is fatal to tar plant populations subject to periodic catastrophic reduction in population size due to restricted habitat.

Red Rock tarplant is subject to herbivory by rabbits and possibly by ground squirrels. Herbivory can be heavy during the dry summer and fall months when other green food is scarce (Faull, 1987). Up to 75% of plants in one population were found to have had their main stem and major branches removed by herbivores, apparently rabbits (Faull, 1987). Heavy predation on both seeds and foliage by California ground squirrels has been recorded on two other species of *Hemizonia* in the Central Valley (Fitch, 1948) and it is expected that at least one of the two ground squirrel species at Red Rock Canyon uses Red Rock tarplant similarly (Faull, 1987). In the Central Valley, tarplants are "important food plants" for ground squirrels, especially in the summer when they are one of the few species that can serve as a moisture source and in the fall when the seeds ripen (Fitch, 1948). The extent of insect predation on Red Rock tarplant is unknown, but some insect predation has been noted on other *Hemizonia* species. The meloid beetle *Epicauda punctata* is known to feed on the flowers and pollen of other *Hemizonia* species (G. Ballmer, pers. comm., 1998) and presumably does on this one as well, as it is a widespread insect. Foliage feeding by two species of tree crickets (*Oecanthus*) has been recorded for

other *Hemizonia* species (Walker and Rentz, 1967). In addition, the larvae of tephritid flies have been recorded as seed predators in the developing heads of at least four species of *Hemizonia*, but Red Rock tarplant has not been studied in this respect (Goeden, 1985; R. Goeden, pers. comm., 1998). Insect predation may be partially controlled by the sticky exudate that covers the foliage of the plants, especially late in the year. Several species of insects have been found trapped and dead in this exudate, including even such large and strong species as honey bees (Faull, 1987).

Pollination in this species has been little studied, but observation by Faull (1987) found that honey bees and small beetles (Coleoptera: Melandryidae) were visiting the flowers. The flowers of other species of *Hemizonia* are reported to be pollinated or visited by insects including flies and moths (Babcock and Hall, 1924) and syrphid and tachinid flies and halictid bees (Tanowitz, 1986). More specific pollination observations on other species of *Hemizonia* involve an andrenid bee, *Calliopsis pugionis* , which commonly gathers pollen and nectar from smooth tarplant (*Hemizonia pungens laevis* ; Visscher and Danforth, 1993; Visscher et al., 1994). The same studies found that Ruths cuckoo bee (*Holcopasites ruthae*) visits *Hemizonia* for nectar only (G. Ballmer, pers. comm. 1998). It is certainly the case that the predominant pollinators of all *Hemizonia* species are insects, but the precise species involved have usually not been clearly identified. Strong evidence for insect pollination in the genus overall includes the yellow color of the flowers and the "clumpy" rather than powdery pollen of *Hemizonia* species in general (Clausen, 1951), a condition that has been confirmed for *H. arida* (pers. obs.).

Seed germination in this species appears to be unstudied. Most species of *Hemizonia* with fertile ray and disk flowers have achenes of different form produced by the two types of flowers. Red Rock tarplant produces few or no fertile disk achenes, but fertile ray achenes are consistently produced. It is normally the case that *Hemizonia* ray achenes have some level of dormancy, while the disk achenes germinate readily (B. Baldwin, pers. comm., 1998). The ray achenes, perhaps the only fertile achenes in this species, could thus play a role in permitting *Hemizonia* species to persist through difficult climatic periods. The extent of ray achene longevity appears unstudied.

Habitat Requirements:

This species occupies seeps, springs and seasonally moist alluvium in an extremely hot and arid part of the Mojave Desert in the rain shadow of the southern Sierra Nevada Mountains. It is reported by Faull (1987) from 1) sandy to gravelly washes, 2) moist alkaline margins of seeps and springs, 3) sandy alluvium at the foot of ridges and cliffs, and 4) ledges of dry colluvium supported by ribs of bedrock on cliffs. The details of the ecological conditions in the latter two habitats need to be further described. There is no indication of the size of the populations in these locations and, based on all earlier descriptions, it appears that the preferred habitat of this species is along the wash bottom. Presumably these alluvial soils, especially those on steep slopes, are somehow moister than the general conditions in the desert, but this needs further investigation. It is possible that the coarse texture of the alluvium allows the retention of moisture at depth, much as does sand in arid area (M. Faull, pers. comm., 1998). The atmosphere cannot extract moisture from the soil beyond a depth of a few inches and so in arid areas coarse or sandy soils are

relatively moist because of good moisture penetration and reduced atmospheric extraction (Walter, 1973).

There are three major geologic formations in the area occupied by Red Rock tarplant. These are a Cretaceous age granophyre (i.e., silica-rich igneous rock), the Miocene age Ricardo group consisting of non-marine sedimentary rocks, and Pleistocene and recent alluvium (Faull, 1987). Faull has noted that Red Rock tarplant is strongly associated with the alluvium derived from the Ricardo group, specifically with the subdivision of that known as the Dove Springs Formation. The Dove Springs Formation consists of two members, and the Red Rock tarplant occurs primarily in alluvium derived from member two, which consists of "pale red to light gray poorly sorted volcanic-plutonic pebble conglomerate, massive to crossbedded, coarse poorly sorted lithic sandstone, and tuff breccia" (Faull, 1987). It is possible that the size of included clasts (rocks) in the conglomerate or the specific mineral content are major factors in the distribution of Red Rock tar plant, but exactly how these might influence the species is unknown.

Occupied soils are sandy to sandy loam and have an alkaline pH of 8.0-9.0 (Faull, 1987). Unoccupied soils have not yet been tested and so any differences cannot yet be described (Faull, 1987). The species occurs at elevations between 2230 and 2820 ft. (680-860 m) according to Faull (1987).

Population Status:

Populations of this species, which were counted at ca. 13,000 individuals in 1986 (Faull, pers. comm., 1998), are scattered over a very small area in the immediate vicinity of Red Rock Canyon State Park. Even within that small area, plants are further restricted to two small areas of moist soil in this arid region. However, all known populations are well protected by the California State Parks Department and are not currently significantly threatened. Populations are stable or increasing and their prospects for survival appear excellent (Faull, 1987; Faull, pers. comm., 1998).

Threats Analysis:

It has been noted that Red Rock tarplants do not survive where they are continuously subject to disturbance by vehicles (Faull, 1987). In the recent past, the primary threat to this species was from off-highway vehicle (OHV) recreational activities. In 1965 the entire crop of this species was believed destroyed by OHV activity (Twisselmann, 1967). Fortunately, however, such activities are now limited by the state park management (Faull, 1987). For example, a population in Red Rock Canyon at Red Cliffs was enhanced by the control of OHV use, camping, and vehicle parking (Faull, 1987; pers. comm., 1998). The recovery of this population after protection from vehicle traffic is evidence both of the effects of such traffic on this plant and of the careful protection the species is currently receiving.

The weedy shrub tamarisk (*Tamarix ramosissima*) shows the potential to dominate the available moist alkaline habitat and to crowd out the Red Rock tarplant (Faull, 1987). Control measures have been initiated by the California Dept. of Parks and Recreation (Faull, 1987).

Historically, cattle and sheep were driven through Red Rock canyon and may have had a severe impact on these plants, though the species was able to withstand this disturbance and survive to the present (Twisselmann, 1967; Faull, 1987). At the time that large herds of livestock were driven through the canyon, the Red Rock tarplant was unknown to science and no detailed observations of the effects of livestock were recorded.

Biological Standards:

Red Rock tarplant appears relatively secure, despite its highly restricted population, because it is being well protected by the Parks Department (Faull, 1987). All known populations now occur on lands directly administered by the California Department of Parks and Recreation (Faull, 1987; Faull, pers. comm., 1998).

The immediate need with respect to the management of this species is to discover the major factors controlling population size and the careful delimitation of the size and boundaries of the existing populations.

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